

## Biological Control Program Annual Report 2007

During 2007, personnel in the Biocontrol program continued several projects from previous years and began rearing an additional predator to attack the hemlock woolly adelgid. A late freeze during the first week in April and the extreme drought across the state doubtless influenced insect populations.

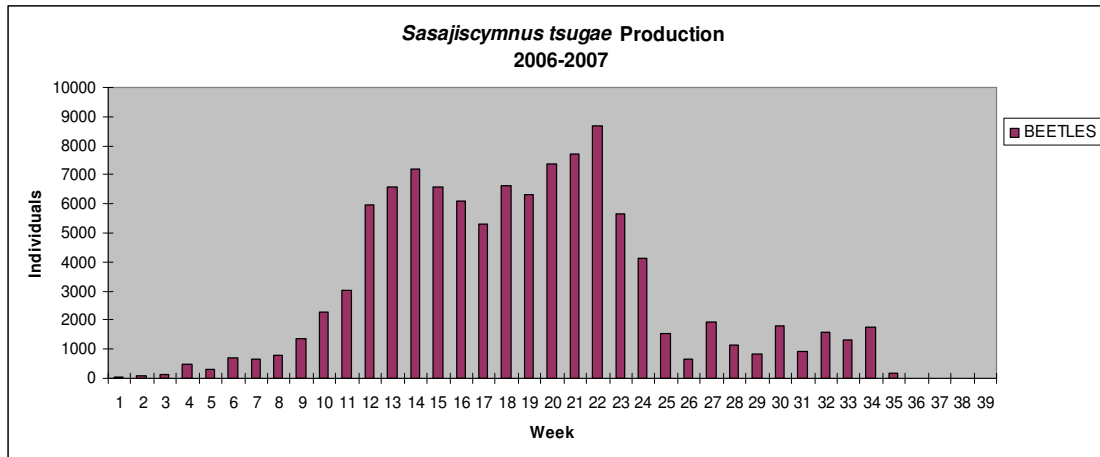
**Hemlock Woolly Adelgid.** The hemlock woolly adelgid (HWA), *Adelges tsugae*, is an exotic and damaging pest of native hemlock trees in both forest and ornamental settings. In eastern North America the adelgid occurs on eastern hemlock (*Tsuga canadensis*) and Carolina hemlock (*T. caroliniana*). The HWA was first found in the eastern US in the 1950s, in Virginia, but in the last decade it has spread at a rate of 20-30 km per year with dramatic population increases. It is now present in most of the range of hemlock in North Carolina, as well as eastern US, and is spreading rapidly in natural areas. It appears that hemlocks at the southern end of their native range succumb to HWA more rapidly than those in the northern regions. Although some chemical control measures are recommended for landscape trees, control with insecticides is difficult in any setting and impractical to impossible in forest settings. Biological control agents (all predators) have been identified in Asia and the Pacific Northwest, and several species have been mass reared and released in stands of hemlock throughout the eastern states.

The primary objective for this project was for NCDA&CS to operate a large-scale central rearing facility to provide biological control agents for the management of hemlock woolly adelgid (HWA), a devastating pest of hemlock trees. *Sasajiscymnus tsugae* (St), native to Japan has been in mass production at the lab since December 2002. Additionally, a small colony of a second species of predator, *Scymnus sinuanodulus* was obtained January 31 from the Mike Montgomery of the Forest Service in Connecticut for rearing on an experimental basis.

Preparations for rearing of *Sasajiscymnus tsugae* began in the fall, cleaning and organizing the lab, and repairing and ordering supplies for rearing. The most intensive rearing started in early January when the adelgid began laying eggs in the lab. Deliveries of beetles to the USDA – Forest Service (FS) began February 14, 2007, with 16 – 18,000 turned over to the Forest Service on a biweekly schedule. During 2006-07, 107,643 beetles were raised, and 97,400 were shipped. Forest Service personnel selected release locations based on microclimate and current phenology of adelgids.

Figure 1 illustrates the seasonal fluctuation of the rearing program. Beetles produced in Week 1 came from jars started 16 October 2006 and egg collection stopped 11 June 2007. Peak production occurred between 1 January and 26 March 2007, synchronized with the progediens egg period. Low temperatures during the first week of April appeared to be detrimental to the HWA population on the hemlock, and production remained lower. The amount of infested hemlock that can be obtained is the limiting factor in production at this time.

Figure 1. Week 1 = 16 October 2006, Week 34 = 11 June 2007.



**Cereal Leaf Beetle.** During the spring of 2007, the cereal leaf beetle (*Oulema melanopus*) (CLB) insectary located at the Piedmont Research Station near Salisbury, NC, was monitored. Eggs of cereal leaf beetle were collected and shipped to the Colorado Department of Agriculture to augment their *Anaphes flavipes* rearing program. Samples of larvae were collected from growers' fields in 4 additional counties and dissected to determine the presence of larval parasitoids.

Populations of CLB in the insectary were extremely low, never going above 1/sq ft on any of the sample dates. Larvae were not collected, but were left in the field for the parasitoids to attack. Adults and larvae were collected in Lincoln and Cleveland counties and added to the insectary. Results are shown in Table 1. All parasitoids found were *Tetrastichus julis*.

Table 1. Cereal leaf beetle dissections 2007.

Date	Location	# Dissected	% Parasitized	# of Parasitoids
20 April	Lincoln Co, Lutz	50	28	3.5/larvae
	Lincoln Co, Wyant	26	42	2.9/larvae
	Cleveland Co, Humphrey	15	46	2.9/larvae
	Cleveland Co, Hudson	30	7	4.0/larvae

***Pseudaulacaspis pentagona*.** Dr. Peter Follett, ARS-USDA, Hawaii, contacted us regarding the identification and possible eventual importation of parasitoids for the biological control of white peach scale, which has become a serious pest of papaya.

Peach branches infested with white peach scale were collected from three North Carolina orchards (22-23 January 2007) by Dr. John Meyer (NCSU). The branches were placed into emergence cages in the Beneficial Insects Laboratory, and parasitoids were collected, identified and preserved. Parasitic Hymenoptera were collected from each of the three locations; a total of 80 *Encarsia berlesei*, 15 *Aphytis proclia*, and 1 unknown. The insects will be given to Dr. Follett, and plans discussed for future work on the project.

***Harmonia axyridis*.** Studies of the introduced multicolored Asian lady beetle *Harmonia axyridis* were continued during 2007.

An experiment set up 30 Oct - 7 Dec 2006 to investigate behavioral patterns of transmission of the fungus *Hesperomyces virescens* among *H. axyridis* during the winter aggregation period was disassembled 13 - 22 March 2007. Mortality was assessed and the surviving insects preserved in alcohol; these will be examined microscopically for the presence of fungus, and the data then analyzed.

Thirty adult *Harmonia axyridis* were collected live on the outside of a light trap on the grounds of the Beneficial Insects Laboratory in Cary, NC, 1 June - 19 July 2007. The insects were frozen to immobilize, then placed into alcohol and stored in the freezer prior to shipping to Robert Koch, Minnesota Department of Agriculture, for his use in molecular studies of the insect.

Two papers were published in professional journals during 2007; a third is in press and should be published before the end of the year:

Nalepa C.A. and A. Weir. 2007. Infection of *Harmonia axyridis* (Coleoptera: Coccinellidae) by *Hesperomyces virescens* (Ascomycetes: Laboulbeniales): Role of mating status and aggregation behavior. *Journal of Invertebrate Pathology* 94: 196-203.

Nalepa C.A. 2007. *Harmonia axyridis* (Coleoptera: Coccinellidae) in buildings: Relationship between body height and crevice size allowing entry. *Journal of Economic Entomology* 100: 1633-1636.

Nalepa, C.A. 2007. Fly catcher effect in *Harmonia axyridis* (Pallas)? No attraction to lady beetle images on flight traps. *Journal of Entomological Science* 42: *in press*.

A poster was prepared and will be presented at the Annual Meeting of the Entomological Society of America in San Diego, CA, 9-12 December 2007: "Attraction of *Harmonia axyridis* to Outdoor Blacklight Traps: Seasonal and Diurnal Pattern in North Carolina", by Christine A. Nalepa

**Imported Fire Ant Biological Control.** The phorid fly, *Pseudacteon tricuspis* has been released in 6 counties in NC over the past 7 years. So far, based on field monitoring no sustained phorid fly populations have been found at any of the past release sites. A small number of *P. tricuspis* flies, 5,206 were released in Scotland County this year, in conjunction with a release of *P. curvatus*.

Scotland County site. *P. curvatus* was released in Scotland County during September 2007. An estimated 13,008 flies were released over a 2 week period starting 10 September. The first generation of phorid flies was found Nov. 1, thirty four days after release. Monitoring for flies will commence in the spring when daytime temperatures reach 70° F or above for several consecutive days.

Wake County site. *Pseudacteon curvatus* was released in Wake Co. in April 2005. After an unseasonably warm winter, monitoring began early and the first phorid fly was found on March 15, 2007 at the Wake county release site. To delimit phorid fly expansion, surveys were conducted in the fall after fly populations had built up and were being found consistently. Less than three years after their initial release in Wake County

phorid flies were found 17 miles from the release site at locations to the east, north and south.

*Pseudacteon curvatus* is showing more potential for establishment in NC than *P. tricupsis*. *P. curvatus* shows a preference for smaller workers common to polygyne colonies and in the field appears more active than *P. tricupsis*. If the population of imported fire ants in NC shifts toward multiple queen colonies, *P. curvatus* will become more important as a management tool. Additional species of phorid flies are being tested by USDA-ARS, and as they become available for release we would like to evaluate them as biological control agents and management option.